Structural Design for More Efficient UV-to-X-Ray Conversion Pellets for Experiments Calling for Short-Duration, High-Intensity Bursts

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Simon Edwards
Research Acceleration Initiative

Introduction

Gold atoms' (or other up-converting metal) electrons, upon reflecting UV laser light, upon being struck with powerful laser light, focus their magnetism toward a point on the far side of the atom (in the direction of angular momentum of the light.) Shining powerful light on pellets of these metals such as gold forces subsequent light to pass through powerful, transient magnetic fields on the far (and to a lesser extent, the near sides) of the gold atoms.

Abstract

In this way, light has two opportunities for each atom to be stepped up in terms of frequency. Recent studies suggest that there is some advantage in using slightly lower-frequency UV light to start with. This may be due to the fact that once light has been converted to X-Ray band energy, subsequent interactions with gold's magnetism do less to alter frequency and more to change angular momentum. Starting with a relatively high frequency of light, while reducing the number of magnetic eddies the light would need to pass through to achieve X-Ray energies, can ultimately lead to scattering. Passing through larger thicknesses of gold create more opportunities for light to be stepped up into the X-Ray band, but eventually also increases the likelihood that already-converted light will be altered in its angular momentum and ultimately, not arrive at its intended destination. At its most extreme, this effect can lead to X-Ray energy moving at an angle perpendicular to the intended flow direction. This is strongly undermines the delivery process as any X-Ray energy moving perpendicular to the overall flow direction will tend to create magnetic eddies that are to the left and right of gold atoms (instead of on the near and far sides,) further amplifying the counterproductive scattering effect.

The fact that angular momentum is necessarily at least somewhat influenced by the gold may be the key to creating pellets with elemental and structural compositions that scatter as little of the converted light as possible.

Fine control of the angular momentum of the emitted light (in support of unidirectionality) is the first ingredient in an efficient conversion process. This is the case only so long as this ingredient is coupled with a pellet with the proper physical structuring.

In experiments such as the noted NIF fusion experiment that lead to ignition on December 5, 2022, efficiency was not the priority. The thickness and the purity of the gold cylinder was emphasized for gold's conductive properties as laser light was hitting the cylinder from multiple angles. While this approach may be suitable when extremely high-powered lasers are available and efficiency is not a concern, the NIF's experimental design is not suitable for

most experiments.

The most efficient configuration of such a metal structure is one which has crystalline alignments and incorporates gaps in strategic zones resembling conical crawlspaces.

This is because light that has been converted into X-Ray energy through such a system will have, if its initial angular momentum was uniform, undergone at least some change to its angular momentum. Any light not yet converted still needs to be converted, but any light already converted needs to avoid further interaction with the gold. We also want structures that help to refocus the X-Rays and direct them toward the intended target.

A more efficient structure therefore would be one consisting of aligned lattices of gold with small vacancies that cut through the lattices. To understand what is meant by this, picture a bundle of fibers one wishes to cut with a sharp blade. One could cut them crosswise (exactly perpendicular to the fiber direction) or parallel to the direction of the fibers. In this case, what we want is a series of cuts that begin somewhat inside of the gold pellet i.e. the outer surface should appear solid with no grooves cut into it. These gaps would not be cuts at all, but deliberate vacancies embedded as part of the manufacturing process. The most efficient angle at which to incorporate these gaps would need to be calculated and would be a reflection of the average change to the angular momentum of the light during that conversion process.

This angle would be a very shallow angle of perhaps six degrees. These tunnels would not be simple two-dimensional lines, but extremely thin cones of empty space within the structure, the vacant area following a path offset by only six degrees from the overall flow direction.

Set behind this cone would be additional cones with increasingly shallow angles. The reason for this is that any UV light that manages to penetrate to a certain depth will, if it achieves a conversion to X-Ray comparatively late, will experience less deviation to angular momentum when it is ultimately converted and this reduced angle of deviation can also be anticipated. This is because passing through crystal-structured gold instead of unstructured gold serves to calibrate the light and consequently, the position and quality of the magnetic eddies.

The conical crawlspaces would would situated about every thousand atomic thicknesses and would span a few nanometers.

The gaps, although taking up a small portion of the overall volume of this proposed pellet design, serve to recalibrate the already-converted light so that when it passes through further thicknesses of gold, it will tend to avoid interaction with the magnetically active areas for the remainder of flight.

Conclusion

This design would maximize the chances of conversion to X-Ray light while minimizing scattering resulting from redundant passes through magnetic eddies. In short, these conical crawlspaces act like a binning mechanism to

ensure that already-converted light is handled differently than that still awaiting conversion.